SCIENCE

FRIDAY, AUGUST 20, 1915.

CONTENTS

The American Association for the Advancement of Science:—
Science and Civilization: DR. W. W. CAMPBELL 227

Industrial Accident Statistics 238

The American Society of Aeronautic Engineers 239

The Organization of Scientific Research in Great Britain 240

Scientific Notes and News 241

University and Educational News 243

Discussion and Correspondence:—
Public Health in America: DR. HAROLD F. GRAY. *The Attitude of the State of California toward Scientific Research:* PROFESSOR WM. E. RITTER. *A Reply to Dr. Little:* MAUD SLYE 243

Scientific Books:—
Skinner on the Mathematical Theory of Investment: PROFESSOR EDWIN BIDWELL WILSON. *Elliot on Prehistoric Man:* PROFESSOR GEORGE GRANT MACCURDY 248

Notes on Meteorology and Climatology: CHARLES F. BROOKS 251

Special Articles:—
On the Reproductive and Host Habits of Cuterebra and Dermatobia: CHARLES H. T. TOWNSEND. *A Rapid Method of counting Bacteria in Milk:* W. D. FROST 253

Societies and Academies:—
The New Orleans Academy of Science: PROFESSOR R. S. COCKS 256

MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

SCIENCE AND CIVILIZATION

THE American Association for the Advancement of Science is sixty-seven years old. It has held annual meetings successively in the eastern centers of population and education, from Boston to Denver and from New Orleans to Toronto. We are today opening the first meeting of the association west of the Rocky Mountains. It gives a more correct impression to note that the Denver meeting of 1901 and the San Francisco meeting are the only ones thus far held west of the Mississippi River cities—in the western three fifths of the United States. The San Francisco meeting has been appointed with the double purpose of encouraging the development of science in the Pacific region and of uniting with other organizations in celebrating the completion of the Panama Canal.

There could scarcely be a better illustration of the relations of science to civilization than the canal supplies. This great waterway has been constructed, not so much by the potency of our national wealth in gold, not so much by the wonderful engineering and administrative ability which we all delight to honor, as by the victory of pure and applied science over the sources of malarial and yellow fever infection. Three centuries of research in the various branches of biology, as pure sciences, inaugurated by Vesalius's anatomical dissections (about 1530), by Harvey's discovery of the circulation of the blood (about 1616), by Hooker's introduction of the

[1] Address of the President, San Francisco meeting, August 2, 1915.

microscope (about 1665), by Leeuwenhoek's discovery of protozoa (1675) and indeed of bacteria (1687), and continued by a succession of unselfish men whose names are as household words to all biologists, had led up naturally to the mighty contributions of Pasteur, Lister and Koch in bacteriology. Then followed, logically, the investigations of Reed and others upon yellow fever infection, and of Laveran, Manson and Ross upon malarial infection. Except for such voluntary tests as were made at the peril of their lives by Doctors Lazear and Carroll in Cuba in the year 1900, in which Lazear paid the extreme penalty of death from yellow fever, and for the tests made by many other volunteers, especially in Italy, as to malaria, in order to determine the precise conditions under which certain mosquitoes transmit these diseases, the canal would not be complete to-day. Our government might not, in fact, have started upon its construction; or, if the government had started blindly to lead the blind, there would have been failure as miserable as that recorded by the French canal company, and for the same reason. We forget unpleasant facts quickly; for example: that of thirty-six brave French nurses who came together to the canal zone, only twelve returned to France; that out of eighteen ambitious young French engineers who crossed the Atlantic on the same ship for service on the canal, only one was alive at the end of thirty days; and that the laborers died by the thousands. The project of constructing the canal was surrendered to an unknown enemy. Let us assume, however, that such sacrifices had prevailed in their purpose and that the canal had been completed in accordance with the engineering plans. With malaria and yellow fever still ruling in the canal zone, and with the zone as a center of infection for all ports of the Atlantic and the Pacific, would a completed canal be a valued asset to commerce, or would it be a constant menace and a nuisance? Let Memphis and Havana and New Orleans answer. A grateful people could worthily erect by the Golden Gate a monument to Lazear, who gave all that he had to make the construction of the canal possible, and to make the completed canal of permanent value.

The minds of all thoughtful people are dwelling daily upon another great application of science—the European and world-wide war. During the past twelve months the resources of the leading European nations have been applied with the utmost intensity to purposes of destruction—to turning the hands of civilization backward. The most recent discoveries in science and the latest inventions are utilized in dealing death to the foe, from the air, from the land, from the sea, and from under the sea. It is a fact that the efficiency of the engines of death in all nations is measured by the state of science in those nations. By way of comment upon this lamentable truth, what shall we who advocate the advancement of science say for the faith that is in us? The prostitution of science to the killing and crippling of men is indeed an ugly fact, but its results are negligible in comparison with the daily ministrations of science to the people's needs. A conflagration may burn a great city; but the inhabitants of that city do not ask that fire, the most useful servant of the human race, shall be banished from their daily lives. The remarkable advance in the civilization of the leading nations during the past four centuries has been due, chiefly, to the hourly and daily influences of accurate knowledge and scientific method; and this advance has been made not by virtue of, but in spite of, wars and the implements of warfare. In this connection, let us note

that the scientific spirit is all but unknown among the Turks, the Moroccans, the Mohammedans in general, the Hindoos, the Egyptians, the Chinese. Amongst all of these peoples, comprising three fifths of the human race, can any one of us to-day recall the names of three men who have contributed appreciably to the advancement of science in the past two centuries? The very limited introduction of scientific method into their countries is the work of alien governors or alien influence. The unscientific nations are threatened with absorption by their more scientific neighbors, not so much because they do not invent or perfect the most powerful cannon, the sturdiest dreadnaught, the speediest aeroplane, or the subtlest submarine, as because the scientific peoples forge ahead of them in the arts of peace, in the modes of thought, in the affairs of daily life. The unscientific peoples are without influence in the world, not because they are unwarlike—the Turks and essentially all Mohammedans are warlike enough to suit the most exacting—but because they are lacking in the every-day efficiency which accompanies the scientific spirit.

The term science may be defined in several ways. From the standpoint which interests us to-day, we may say that science is the relationship of cause and effect. Wherever we observe an effect there has been a cause; wherever causes are operating there will be effects. The same causes, acting under precisely the same conditions, will produce precisely the same effects. This is the experience of every investigator in every subject, and no one has the slightest reason to doubt the correctness of the principle. There is no room for the operation of the arbitrary and the capricious; in fact, the arbitrary and the capricious do not exist in nature. If in one case out of a hundred the result which interests us is different from what we had expected we may rest assured that in this one case some change occurred in the forces acting; a new force entered, an old force became inoperative, or the relative intensities of the active forces changed. When we do not understand why certain events occurred it means that we do not understand the forces which acted to produce the events. The correct explanation of the events means that we have isolated the causes and have been able to express the laws of their action.

The forces which have interested mankind, range from those cosmic forces which operate on a scale so stupendous that we have no control over them, down through those forces which we can control to a limited extent, and on to those which are absolutely subject to human control. We are not able to limit or to increase the output of the sun's heat, and we can not guide the movements of the comets, planets and stars in their orbits. We do not know how to stay the wind and the rain, but we can apply them, in a limited degree, to our purposes, and we can do much to protect ourselves from their injurious effects. The forces which govern the daily life of the individual, the community and the nation, and which govern the relations of individuals, communities and nations to each other are, with rare exceptions, either absolutely under human control or such control is a hopeful aspect of the near future. These forces are the means to certain logical ends, and we can not question that they also operate unerringly according to law. Whether they shall be applied for civilization or against civilization is for man to decide. The automobile may be used to bring the physician on an errand of mercy, or to hasten the robber to a place of concealment and immunity. High explosives will cut a canal through the Culebra ridge, or deal destruction from a twelve-inch shell.

The American army may establish local self-government in Cuba from the highest of humanitarian motives, or it may wage a war of conquest on a weak neighboring country from the low motive of increasing the power of human slavery as a national institution.

From our experiences upon the earth we have learned to place faith in certain simple laws of nature, amongst which are the following:

1. Every particle of matter attracts every other particle of matter, in accordance with the law of gravitation.

2. Heat always flows from a hotter body to a colder body.

3. The volume of a given quantity of gas or vapor is a function of the temperature and pressure to which it is subjected.

If a rifle, elevated at a certain angle above the level surface of a lake, gives a certain muzzle velocity to the bullet, the bullet will describe the curve which the law of gravity says it should describe, and strike the water where the law says it should strike, provided we take into account two small factors that are also acting—the resistance of the air and the rotation of the earth.

A red-hot cannon ball and a red-hot bullet, thrown into a great bank of snow will both cool down to 32° Fahrenheit; the great cannon ball slowly and the little bullet rapidly.

A rubber balloon containing a given quantity of hydrogen gas can be so proportioned that if thrown from a high tower on a hot summer day it will expand and rise, or on a cold winter day it will contract and fall.

If a comet, a hundred million miles away, more or less, is observed very accurately as to its direction from us to-night, again next Monday night, and a third time in two weeks from to-night, Newton's law of gravitation will enable us to determine the curve in which the comet is traveling around the sun, and to say where the comet may be seen three months or six months later.

The great stars and the small stars radiate their heat energy into surrounding space: the great stars cool off extremely slowly, and the small stars comparatively rapidly. Examples of this principle, it is believed, are the great sun, on the one hand, its volume 1,300,000 times the earth's volume, its surface temperature higher than 10,000° Fahrenheit, and its interior temperature immensely higher yet; and the little earth, on the other hand, cool on the surface and relatively cool in the interior.

As the great gaseous suns radiate their heat energy unceasingly into surrounding space, they undoubtedly grow slowly smaller under the force of their own internal gravitation which strives constantly to pull each molecule of gaseous matter to the centers of the stars.

There is every reason to believe that the three simple laws which we have quoted and illustrated are fundamental, and operate invariably throughout the stellar universe.

And so it is, as far as human experience has gone, with all the laws of nature.

To some people this infallible and universal obedience to law—the strict accountability of effect to cause—seems a hard and cruel fact and counter to idealism in its various forms. This is a hasty and faulty view. It is the cause-and-effect relationship which gives us something dependable upon which to build our civilization. The recognition of this principle, whether conscious or unconscious, is the chief difference between modern civilization and the civilizations which prevailed in the days of the inquisition and of the Salem witchcraft. Looking at the subject from the idealistic standpoint, the conception that all matter in the universe is en-

dowed with the property of obeying law—unalterably obeying law—is incomparably grander than the conception of one law prevailing here, another law prevailing there, of irresponsible caprice operating both here and there.

History affords no more remarkable phenomenon than the retrograde movement in civilization which began with the decline of Roman power and continued for more than a thousand years, approximately to the epoch of the Borgias, Columbus and Copernicus. There had once existed a wonderful Greek civilization, but for twelve or fifteen centuries it was so nearly suppressed as to be without serious influence upon the life of the European people. Greek literature, one of the world's priceless possessions, not surpassed by the best modern literatures, was as complete two thousand years ago as it is to-day. Yet in the middle ages, if we except a few scattered churchmen, it was lost to the European world. A Greek science never existed. Now and then, it is true, a Greek philosopher taught that the earth is round, or that the earth revolves around the sun, or speculated upon the constitution of matter: but excepting the geometry of Euclid and Archimedes, we may say that nothing was proved and that no serious efforts were made to obtain proofs. There could be no scientific spirit in the Greek nation and civilization as long as the Greek religion lived and the Greek people and government consulted and were guided by the Greek oracles. If there had been a Greek science, equal in merit with modern science, think you that stupidity and superstition could have secured a strangle hold upon Greek civilization and have maintained a thousand years of ignorance and degradation? Intellectual life could not prosper in Europe as long as dogma in Italy, only 300 years ago, in the days of Bruno and Galileo, was able to say, "Animals, which move, have limbs and muscles; the earth has no limbs nor muscles, therefore it does not move;" or as long as dogma in Massachusetts, less than 250 years ago, was able to hang by the neck until dead the woman whom it charged with "giving a look toward the great meeting-house of Salem, and immediately a demon entered the house and tore down a part of the wainscoting." It was the rebirth of science, exemplified chiefly by astronomy, and secondarily by medicine, which gave to the people of Europe the power to dispel gradually the unthinkable conditions of the middle ages.

Shall we try to estimate what astronomy, an ideal science, sometimes called an unpractical science, has done for mankind? We shall not dwell upon its so-called practical applications, such as the supplying of accurate time, the sailing of ships precisely to their destinations on the other side of the great oceans, the making of accurate maps of the continents and islands, the running of boundary lines between nations, the predicting of times of high and low tides, and so on; we shall consider only the pure knowledge side of the subject.

Conceive of the earth as eternally shrouded in thick clouds so that the earth's dwellers could never see the sun, the moon, the stars and the nebulæ, but not so thick that the sun's energy could not penetrate to the soil and grow the crops. Under these conditions, we might know the earth's rock strata to the depth of a mile or two, we might know the mountains and the atmosphere to a height of two or three miles, we might acquire a knowledge of the oceans, but we should be creatures of exceedingly narrow limits. Our vision, our life, would be confined to a stratum of earth and air only four or five miles in thickness. It would be as if the human race went about its work of raising corn for food and cotton

for raiment, always looking down, never looking up, knowing nothing of the universe except an insignificant stratum of the little earth. This picture is only a moderately unfair view of life as it existed on our planet four hundred years ago, before the days of the telescope, the spectroscope and the photographic plate, and before the days of freedom of speech and thought. The earth is no longer flat, supported on the back of a great turtle which rests upon nothing; it is round, and we know why; and it revolves around the sun in exact obedience to law. The stars are not lanterns hung out in the sky by angels at night; they are suns, hundreds of millions of suns, each on the average comparable in size to our sun. Exists there an intelligent man in the world whose thoughts, every day and many times a day, are not adapted to these facts? Who can estimate the value of this knowledge to the human race?

We have not yet seen little earths revolving around any stars except our own, nor do we know that intelligent beings live upon such planets and are looking down toward our system and seeing our sun as a little star in their night sky; but everybody now holds as absurd the view that our star is the only one of the hundreds of millions of stars which has little planets revolving around it, or that our earth is the only one that is inhabited by intelligent life. Can there be a more inspiring thought than that intelligent beings are probably living here and there throughout the universe, in whatever direction we may look? The spectroscope has shown that the chemical elements which compose the earth are also the constituents of our sun and of the other suns. We have no reason to doubt that the chemistry of the earth is the chemistry of the universe. The spectroscope and the photographic plate are telling us of the close relationship of the nebulæ to those stars which we call the youngest stars, of the young stars to the middle-aged stars, and of the middle-aged stars to the old stars. We can not doubt that the stars are growing older, as we are growing older, as everything in nature is changing and growing older, and in accordance with the same laws which govern the changes on the earth. The student of double stars finds that the movements of the two components of a distant double star system are in accordance with the law of gravitation. Every particle of our experience leads us to believe that the reign of the laws which control our everyday affairs is universal; that the strict relationship of cause and effect applies throughout the stellar system. Does not this broad and stable foundation give valued confidence to those who are building the structure of the other sciences, the structure of everyday life, the structure of civilization?

The purpose of the American Association is the advancement of science in all its branches. Its scope is sufficiently broad to include every subject that is studied scientifically. Papers on the evolution of language, on the functions of governments, on the history of religions, if based upon the relations of cause and effect, have the same rights and privileges and the same welcome upon our programs as papers concerning the spectrum of the latest comet, the atomic weight of helium or the origin of volcanoes.

It is now quite difficult to find a subject that is not being studied scientifically somewhere by somebody. It is this fact which accounts for the phenomenal progress of civilization in the past half century, and especially in the last thirty years. With rare exceptions, all important interests are pulling together for the welfare of mankind, and their efforts are effective because they are advancing over the firm foundation of scientific method. Every branch of

science, every nation's literature or art, every element of "religion pure and undefiled," every element of commerce conducted upon the dignified basis of mutual respect and mutual profit of buyer and seller, is a contributor to the forward movement. It would be a pleasure to support this thesis by reference to definite contributions in many subjects, but time is available for only a few accomplishments of the past and a few needs of the future.

The discoveries in preventive and curative medicine undoubtedly rank amongst the most valued contributions to civilization in the entire range of scientific research. I am disposed to place the names of Louis Pasteur, Joseph Lister and Robert Koch very high on the list of the world's great benefactors. Pasteur was a professor of chemistry whose first investigations lay in the domain of abstract chemistry, and his subsequent successes, which put the world in the way of preventing and eradicating all infectious diseases, proceeded naturally from his application of the methods of research in pure chemistry to the problems of fermentation. He proved that wine, beer and milk ferment and turn sour because minute organisms, always present in the atmosphere, invade these liquids, multiply enormously and corrupt them. Break the skin of the grape, the atmospheric parasites enter the wound and fermentation develops. Exclude the air, or destroy the germs in the air, the wound in the vegetable structure remains clean and healthy indefinitely.

These discoveries by Pasteur attracted the immediate attention of Lister, who applied them in surgical operations. Antiseptic surgery, one of the most glorious works of man, is the result.

Pasteur proceeded upon the theory that just as fermentation is the work of foreign organisms, so certain diseases of animal life are the work of microbes which have entered the body of the sufferer. His first successes in preventive medicine related to cholera in the French fowls, and anthrax in the French cattle and sheep. His treatment reduced the death rate of the fowls and animals from about ten per cent. to less than one per cent. The great British authority, Thomas Huxley, estimated that the savings in these sources of wealth to the French nation in two decades were sufficient to pay the war indemnity of 1871. Proceeding further along the same lines, Pasteur inaugurated the curative treatment of hydrophobia. The fatalities from this horrible malady dropped suddenly from nearly one hundred per cent. to less than one per cent. Do we realize that this was only thirty years ago?

In the next three decades followed the preventive and curative treatments by several renowned investigators for diphtheria, tetanus, yellow fever, malaria, spinal meningitis, typhoid fever and other maladies. Progress has been notable in the treatment of tuberculosis, bubonic plague, cholera, typhus fever and sleeping sickness. There are faith and hope in the future as to preventives and cures for tuberculosis, scarlet fever, measles and cancer. The practise of extreme cleanliness and the use of anesthetics in surgery have enabled surgeons to reach hitherto inaccessible parts of the body, to reduce the death rate enormously, to diminish the suffering of the patient, and to afford health and strength after healing. Wonderful operations upon the brain, upon intestines, upon severed nerves, veins and arteries are now performed. The general health of communities has been improved by the theory and practise of cleanliness and fresh air. The average length of life has increased by many years since the principles discovered by Pasteur have been applied. The increase has been greatest for

children and women and those not in robust health, but it has also been great for those healthy men who have been accepted as risks by the life insurance companies. Life insurance business has been based upon mortality tables which represented the expectation of life under the relatively unhealthy conditions which existed a half century ago. Those tables do not fit modern conditions. The number of deaths is now smaller than the insurance tables predict. This means that the actual cost of insurance is correspondingly reduced. The statistics for the saving from this source are not readily available. It can be said, however, that the increase in the duration of the lives of those healthy men who carry insurance, during the past thirty years, has meant a money saving greater in amount than all the expenditures ever made by the universities, research institutes and individuals in support of medical investigation. This reckoning does not include the saving of the lives of women and children, nor take into account the economic values of the lives of the men, women and children saved. The reckoning likewise omits the vastly greater factor of human happiness which proceeds from healthful and complete family life.

We have referred at considerable length to progress in medical science and have said that this progress followed naturally from Pasteur's investigation of fermentation as a problem in pure chemistry. We do not intend to detract in any sense or to any extent from the glory of Pasteur's work, from the glory of Lister's, Koch's, Roux's, Behring's, Ross's, Ehrlich's and Flexner's services, when we record the simple fact that the structures which they erected and which mankind is finding of incalculable value were built upon the broad and firm foundations which the earlier investigators in biology and chemistry had made ready.

The development of the other subjects which have become so vital in modern life have essentially paralleled that of biology, chemistry and medicine.

It is so well known as to be a trite subject that electricity was studied a full century, following Volta and Galvani, before it was seriously applied to the arts. It is not so well known that the immense value of electricity in current life, as applied by the electrical engineers, is due chiefly to the work of two men: Faraday, in the Royal Institution of London, who, studying electricity as a pure science and with no apparent thought for its possible applications, discovered the principles of magneto electric currents, upon which all modern dynamos and transformers, electric lighting, telephoning and telegraphing, and the transmission of power depend; and Maxwell, of Cambridge University, who wrought Faraday's results into a foundation of complete and rigorous theory upon which future electrical engineers might build.

The X-rays and radium are the products of research in pure science, and quite regardless of so-called utility; yet what is to-day more useful than the X-rays, and what promises greater usefulness than radium and its related radio-active substances?

Pure science studies in the broad fields which we may call botany and chemistry have made scientific agriculture possible. We can not exaggerate the importance of science in farming for the future of the human race.

A few months ago the people of the Pacific coast acquired the power of telephoning directly to Atlantic coast points. Newspaper accounts made much of the fact as a great advance, and so it was; but the newspapers left Hamlet out of the play. Improvements in the insulating system, to reduce losses of current along the line, were

involved; but Bell at New York and Watson in San Francisco inaugurated the long-distance conversations by using the same transmitters and receivers which these same gentlemen had used in the beginning of telephoning, in 1876, over the line two miles long between Boston and Cambridge. The great improvements in the thirty-nine intervening years lie elsewhere in the system. It is possible for San Francisco to talk with New York and Boston, and at quite reasonable expense, because Professor Pupin, of Columbia University, as a result of systematic study, construction and test, discovered that by placing his invention, the so-called "loading coils," at certain appropriate intervals in an electric line, thus making what electricians call a suitable balance between inductance, electrostatic capacity and resistance, the current could be compelled to go through to its distant destination with little loss of strength. Pupin's loading coils are inserted at frequent intervals in the San Francisco-New York line. It might be possible to construct a line without the Pupin coils which would let us talk directly with New York, but the installation expenses for very large copper wires and other costly items would be so high as to impose prohibitive tolls. The happy result has been reached because the telephone company combined an exceedingly liberal and far-seeing policy with the latest discoveries in electricity as a pure and applied science; and all concerned are entitled to receive the grateful thanks of the Pacific and Atlantic peoples.

Wireless telegraphy has been a priceless servant to those whose friends go down to the sea in ships. It has averted many frightful disasters in the past decade. This branch of electricity was made possible by the researches of the lamented Herz and others who studied the properties of electrical waves as we study the light from the nebulæ—from the point of view of pure knowledge.

While the foundations of the sciences have, for the most part, been laid under the auspices of the universities and the special research institutions, it is usually the combination of men of science and successful men of affairs which makes the sciences useful to the people in general, and therefore great factors in the advancement of civilization. To mention only one subject, electricity: we can not compute the world's indebtedness to the pioneers, Volta and Galvani, nor to the great developers of the subject, Faraday and Maxwell; but it is a fact that electricity did relatively little for mankind in general before the year 1865. The world is unable to compute its indebtedness to Edison, Bell, Marconi and other great inventors and business men combined who have brought electricity to everybody's house and office, to every factory, to every village, to every ship as an obedient and ever-ready servant. That these gentlemen have made commercial successes of their ventures seems to have caused certain persons to lose interest in them as men of science. I have no sympathy with that point of view. Only those who have tried it can know how much courage is required to risk everything in a new venture, how many hours of day and night are given to thought of the subject from all possible angles, how unceasingly must be the maintenance of discipline in great business organizations. Not only is financial success doubly earned, and most desirable as an incentive to the succeeding generations, but financial success is absolutely synonymous with making the subject useful to mankind. It is a fortunate fact that there are Stephensons and Fultons, Edisons and Marconis, as well as Newtons and Laplaces, Darwins and Helmholtzes. The latter have laid the foundations broad and deep, but the former have

erected superstructures upon these foundations which the civilized world is using every minute with great advantage. And, further, these structures, which are visible in the daily life of the people, are the incentives which lead to the provision of splendid opportunities for the extension of the foundations. The value of science as a factor in advancing the race depends at least as much upon the applied as upon the theoretical side. There can be no durable structure without the foundation, but the foundation alone, possessing wonderful potentiality, is largely a latent force. History confirms the view that real progress in civilization is most rapid when applied knowledge is not too far behind theoretical knowledge.

There is a valuable lesson in this principle it seems to me, for the newly organized Pacific Division of the American Association; and perhaps I, as a representative of the most ideal of all the sciences, can with propriety outline the lesson. It is a fortunate thing that the astronomer, the geologist, the psychologist, each regards his pure science as the finest of all the sciences; it is easy to remember that medicine and surgery are returning many fold the financial support extended to them, and that agricultural science is a field of extreme need and promise; but what we should especially remember is this: a significant advance in science is not possible if the intellectual life and the physical life of the Pacific region people are seriously neglected. We should use the utmost endeavor to encourage the introduction of scientific method into the fields, the factories, the homes, the construction and care of roads, the improvement of waterways, the building of cities. There is something which every member of the Pacific Division can do to carry the leaven of scientific method into the life of his community. It is not excusable to be a pessimist, yet one can not travel, one can not be thoughtful, one can not be awake without seeing unscientific methods prevailing on every hand. Recall how often some one street in your town has been torn up for repaving in the last twenty-five years. Does the asphaltum on all the streets in your city remain firm and smooth, or does it become wrinkled and bumpy under the summer sun? Were the specifications for the asphaltum written by a man of science—a real engineer—or were the so-called improvements made under the auspices of the politicians? ..

There are a great many problems in the general government of our country, some of them of extreme importance, which ought to be solved along scientific lines and yet are not. The friends of high protective tariffs were in command of our government during several decades following the civil war. The friends of low tariffs, or tariffs for revenue only, when placed in command, made sudden reductions of considerable extent to meet their own views. Six years ago the schedules were sent up to record high levels, and four years later they were sent down to record low levels. The subjecting of business to such sudden changes and strains is unscientific in the extreme. We should say in fairness that the voters do not desire the schedules to fluctuate violently. No political party has received a mandate from the people in the last thirty years to revise the schedules to a new high level or to an extreme low level. The unhappy situation seems to be the fault of the machinery of control. The problem is a scientific one to which comparatively few members of congress have given conscientious study. All of the forces of interstate and international commerce are acting, not simply once in four years when the administration changes, but monthly and constantly. The schedules should be formu-

lated, in accordance with the country's adopted policy, by thoroughly trained and widely experienced students of economics; by a permanent commission, if you please, composed of the ablest economists that love of country and very high salaries will secure. These facts are recognized in many other countries, but not so by our governing forces. This is not a plea for high tariffs, or for low tariffs, or for moderate tariffs; it is a plea for reasonable stability of tariff schedules, and for a scientific treatment of the subject.

It would seem that the greatest need of the times is in the science of international relationships, to the end that truth and reason may replace deception and brute force. The word diplomacy should be rescued from the dictionary definition, "artful management with the view of securing advantages." The diplomat who seeks the advantage of his country at the expense of another is proceeding on immoral and unscientific lines, and the chances are strong that he is not a benefactor of the human race. He is liable to set in action forces of antagonism which were better not aroused. International settlements which are compelled by victorious war, or by the threat of a great army or a great navy in the background, settlements which do not take account of mutual interests, settlements which neglect the relations of causes and effects, are apt not to be settlements at all. They generally lead to unhappiness, retrogression and violence. It is a fearful comment upon diplomacy that Europe has had wars nine years out of ten since the beginnings of historical records.

It ought to be clear to historians that the forcible bringing into one country of a province, forcibly taken from an adjoining country, which speaks a different language and possesses different temperament and ideals, is in general a grievous mistake. It is usually a misfortune for both countries, especially if the two countries are of approximately the same degree of civilization. The repression of native language and customs, and the constant presence of alien governors, produce reactions which are as natural as the falling of an apple from the tree to the ground. If the economist is interested in balancing the finances of such a case he will seldom have difficulty in proving that the cost of holding the province for the conqueror is greater than the province is worth; and the cost of planning to get the province back is greater than the province is worth. The issues between the two countries are not settled by the process; they are left more unsettled than ever; and eventually the whole world may have to pay the cost of the false solution. It can not be pretended that wars in general settle international questions either justly or permanently; they merely repress certain forces until natural developments cause these forces to break out anew. A mistaken sense of national honor, usually combined with national selfishness, leads to settlements which are merely temporary. Settlements along scientific lines, settlements which consider cause and effect in the decades that are to follow, are so rare as to be negligible. There is scarcely any hope that the present inexcusable war will settle the differences between the nations, if the final adjustments are left to the professional diplomats of Europe. Some difficulties may be threshed out, but a new crop of difficulties will almost certainly be sown for a later generation to reap. It is an infinite pity that the plain lessons of history are so often forgetten in moments of international passion.

I should not like to have it thought that this is a plea for peace at any cost. I am speaking of war in general; there are exceptions when not to fight would be more

unfortunate than war; but just settlements of wars would go far to prevent war.

The human race needs above everything else the conviction that the principles of science rule everywhere, and that the problems of personal and national life are not solved so long as any important forces are ignored. The need is especially great in our own country where isolation from other countries and the existence of immense reservoirs of natural resources have let us seem to keep up with international progress in spite of our wasteful and inefficient methods. It were well to recognize that entry upon world affairs, which we can not long avoid, will reveal costly weaknesses.

The appeal of science for the adoption of scientific methods in the daily life of the people, in the governments of community, state and nation, in the settling of international questions, is not an appeal for efficiency at all costs. The life that is forever bent over the exact equation, two plus two are four, a life that tries to express all its experiences in equations equally exact, is liable to be narrow, distorted, unhappy and misspent. The man who worships scientific efficiency, like the man who is a slave to gold, or the man who pushes his religion too far, may acquire a harsh and selfish view of life; pity and charity may drop out of his vocabulary.

Our appeal is for the scientific method of treating the problems which are before us for solution. The scientific method is that which takes account of all the forces acting. It is therefore the just method. It is in full harmony with the Golden Rule, "Do unto others as you would have others do unto you." It is, if you please, in full harmony with the spirit of Christ. Support is given to research by the governments and by generous men and women in order that the truth may be found and be made available in the service of mankind. The investigational laboratories of the universities, the observatories, the private institutions for research, have precisely these ideal purposes, and no other purpose. The various activities of the world contribute to the advancement of civilization in proportion as they contain the ideal and the unselfish. That which is purely practical, containing no element of idealism, may sustain existence and to that extent be valuable, but it does not civilize. I believe it is the idealism of pure knowledge, the idealism in applied knowledge, the idealism in industry and commerce, the idealism in literature and art, the idealism in personal religion, which leavens the life of the world and pushes forward the boundaries of civilization.

W. W. Campbell

INDUSTRIAL ACCIDENT STATISTICS

The United States Bureau of Labor Statistics of the Department of Labor has just issued as Bulletin 157 a report on Industrial Accident Statistics by Frederick L. Hoffman. The adoption of the principle of workmen's compensation by more than half of the states within the last few years emphasizes the importance of the industrial accident problem and foreshadows the time when such compensation for industrial accidents will become universal throughout the United States.

As one method of measuring this importance, the bulletin presents an estimate of the number of fatal and nonfatal industrial accidents occurring among American wage-earners in a single year. The conclusion reached is that the number of fatal industrial accidents among American wage-earners, including both sexes, may be conservatively estimated at 25,000, and the number of injuries involving a disability of more than four weeks, using the ratio of Austrian experience, at approximately 700,000. These numbers, impressive as they are, fail to indicate fully the number of industrial accidents, for such studies as have already been made show that of the accidents involving disabilities of one day and over at

least three fourths terminate during the first four weeks.

The industries which contribute the greatest number of fatal accidents are railroad employments and agricultural pursuits, each group being responsible for approximately 4,200 fatalities each year. Coal mining contributes more than 2,600, and building and construction work nearly 1,900. General manufacturing, while employing large numbers, produces only about 1,800 fatal accidents. When the fatality rates are considered, metal mining ranks as most hazardous, with a rate of 4.0 per 1,000, coal mining coming next with a rate of 3.5, and fisheries and navigation following with a rate of 3.0 per 1,000. Manufacturing industries as a whole rank lowest, with a rate of 0.25 per 1,000, but the fact should not be overlooked that this low average rate covers manufacturing groups varying widely in hazard, including, on the one hand, boiler making and the various departments of the iron and steel industry, in some of which fatality rates as high as those in metal and coal mining have prevailed, and, on the other hand, the textile and clothing industries, in some of which the risk of fatal accident is practically negligible.

These estimates are derived from the best sources available. At the present time there are no entirely complete and trustworthy industrial accident statistics for even a single important industry in the United States. This lack of trustworthy industrial accident statistics is due to the absence of any uniform requirements in the various states as to the reports of industrial accidents. Prior to the establishment of workmen's compensation systems, no state received reports of all the accidents, or even of all the fatal accidents in its industries.

THE AMERICAN SOCIETY OF AERONAUTIC ENGINEERS

THE American Society of Aeronautic Engineers, which was organized at the request of Mr. Thomas A. Edison, and which was requested by the secretary of the navy to appoint two members to serve on the navy's advisory board, has, after polling its members for their selection, nominated Messrs. Henry A. Wise Wood and Elmer A. Sperry, together with a special committee of the following aeronautic engineers and experts to cooperate with them:

Orville Wright, Glenn H. Curtiss, W. Starling Burgess and Charles M. Manly, to advise on matters pertaining particularly to the theory and construction of aeroplanes and aeronautical motors.

Peter Cooper Hewitt, John Hays Hammond, Jr., and Joseph A. Steinmetz, to advise on matters pertaining particularly to the application of aircraft for warfare.

Captain Thomas S. Baldwin, A. Leo Stevens, Ralph H. Upson and Raymond B. Price, to advise on matters pertaining particularly to dirigibles, balloons and parachutes.

Messrs. Henry A. Wise Wood and Elmer A. Sperry constituted the popular selection, being nominated by eight tenths of the total votes. Both are scientific engineers, recipients of the Elliott Cresson and John Scott gold medals of the Franklin Institute, respectively, awarded for inventions of a basic character. Mr. Wood is president of the American Society of Aeronautic Engineers, vice-president of the Aero Club of America, and was a member of the aerodynamics laboratory committee appointed by President Taft in 1912. Mr. Elmer A. Sperry is vice-president of the American Society of Aeronautic Engineers. The Sperry gyroscopic stabilizer for aeroplanes in June, 1914, was awarded the first prize for safety devices of $10,000, by the French government.

The special committee of aeronautic engineers and experts was appointed as a result of many suggestions received from members of the society who, in sending in their selections, pointed out that no two men in aeronautics to-day have expert knowledge of every branch of the science of aeronautics. In most cases, therefore, they proposed additional names of experts in different branches of the science.

In the organization of the American Society of Aeronautic Engineers it was provided for the addition of directors to be appointed as

follows: Two by the army, two by the navy, one each by the Smithsonian Institution, the Post Office Department, the Weather Bureau, the Bureau of Standards, the Massachusetts Institute of Technology and the University of Michigan. The society has received a large number of applications for membership, but it is the intention of the executive board to apply the severe requirements of such technical societies as the American Institute of Electrical Engineers and the American Society of Mechanical Engineers in passing upon candidates for membership.

THE ORGANIZATION OF SCIENTIFIC RESEARCH IN GREAT BRITAIN

Particulars of a "Scheme for the organization and development of scientific and industrial research" were issued on July 26 by the British Board of Education in a document signed by Mr. Arthur Henderson. The scheme is designed to establish a permanent organization, and it is pointed out that the research done should be for the kingdom as a whole, and that there should be complete liberty to utilize the most effective institutions and investigators available, irrespective of their location in England, Wales, Scotland or Ireland. There must, therefore, be a single fund for the assistance of research under a single responsible body.

The scheme provides for the establishment of:

a. A committee of the privy council responsible for the expenditure of any new moneys provided by parliament for scientific and industrial research;

b. A small advisory council responsible to the committee of council and composed mainly of eminent scientific men and men actually engaged in industries dependent upon scientific research.

The committee of council will consist of the lord president, the chancellor of the exchequer, the secretary for Scotland, the President of the Board of Trade, the president of the Board of Education (who will be vice-president of the committee), the chief secretary for Ireland, together with such other ministers and individual members of the council as it may be thought desirable to add.

The first non-official members of the committee will be: The Right Hon. Viscount Haldane of Cloan, O.M., K.T., F.R.S., The Right Hon. Arthur H. D. Acland, and The Right Hon. Joseph A. Pease, M.P.

The president of the board of education will answer in the House of Commons for the sub-head on the vote, which will be accounted for by the Treasury under Class IV., Vote 7, "Scientific Investigations, etc."

The first members of the Council will be: The Right Hon. Lord Rayleigh, O.M., F.R.S., LL.D., Mr. G. T. Beilby, F.R.S., LL.D., Mr. W. Duddell, F.R.S., Prof. B. Hopkinson, F.R.S., Prof. J. A. M'Clelland, F.R.S., Prof. R. Meldola, F.R.S., Mr. R. Threlfall, F.R.S., with Sir William S. M'Cormick, LL.D., as administrative chairman.

The scheme is designed to establish a permanent organization for the promotion of industrial and scientific research. It is in no way intended that it should replace or interfere with the arrangements which have been or may be made by the war office of the admiralty or ministry of munitions to obtain scientific advice and investigation in connection with the provision of munitions of war.

The primary functions of the advisory council will be to advise the committee of council on: (i) proposals for instituting specific researches; (ii) proposals for establishing or developing special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades; (iii) the establishment and award of research studentships and fellowships.

The advisory council will also be available, if requested, to advise the several education departments as to the steps which should be taken for increasing the supply of workers competent to undertake scientific research.

Arrangements will be made by which the council will keep in close touch with all government departments concerned with or interested in scientific research and by which the council will have regard to the research work

which is being done or may be done by the National Physical Laboratory.

It is planned that the advisory council should act in intimate cooperation with the Royal Society and the existing scientific or professional associations, societies and institutes, as well as with the universities, technical institutions and other institutions in which research is or can be efficiently conducted.

It is proposed to ask the Royal Society and the principal scientific and professional associations, societies, and institutes to undertake the function of initiating proposals for the consideration of the advisory council, and a regular procedure for inviting and collecting proposals will be established. The advisory council will also be at liberty to receive proposals from individuals and themselves to initiate proposals.

It is contemplated that the advisory council will work largely through sub-committees reinforced by suitable experts in the particular branch of science or industry concerned. On these sub-committees it would be desirable as far as possible to enlist the services of persons actually engaged in scientific trades and manufactures dependent on science.

The advisory council will proceed to frame a scheme or program for their own guidance in recommending proposals for research and for the guidance of the committee of council in allocating such state funds as may be available. This scheme will naturally be designed to operate over some years in advance, and in framing it the council must necessarily have due regard to the relative urgency of the problems requiring solution, the supply of trained researchers available for particular pieces of research, and the material facilities in the form of laboratories and equipment which are available or can be provided for specific researches.

Office accommodation and staff will be provided for the committee and council by the board of education.

SCIENTIFIC NOTES AND NEWS

THERE is published in this issue of SCIENCE the address of the president of the American Association for the Advancement of Science, Dr. W. W. Campbell. We hope to publish in subsequent issues other addresses given at the Pacific Coast meeting, together with reports of the proceedings of the sections.

FREDERIC WARD PUTNAM, emeritus professor of American ethnology and archeology in Harvard University, honorary curator of the Peabody Museum, permanent secretary of the American Association for the Advancement of Science from 1873 to 1898 and president of the association in 1898, distinguished for his contributions to anthropology, died at Cambridge, on August 14, in his seventy-seventh year.

JOHN ULRIC NEF, head of the department of chemistry in the University of Chicago, eminent for his contributions to organic chemistry, died on August 13 at the age of fifty-three years.

DR. FRANCIS X. MAHONEY has been appointed health commissioner of Boston.

THE Ontario government has appointed a commission to investigate the production and shipment of nickel in relation to the conditions created by the war. The members are Mr. G. T. Holloway, of London (chairman); Professor W. G. Miller, provincial geologist; Mr. McGregor Young, K.G., Toronto, and Mr. T. W. Gibson, deputy-minister of mines.

THE directors of British Dyes (Limited) are establishing a research department, and have invited Dr. G. T. Morgan, F.R.S., of the Royal College of Science for Ireland, Dublin, to become the head of the department. They have named a technical committee to consist of Dr. M. O. Forster, F.R.S., chairman, Dr. J. C. Cain, Dr. G. T. Morgan, F.R.S., and Mr. J. Turner. An advisory council, under the chairmanship of Professor Meldola, F.R.S., is also to be appointed.

DR. EDWARD W. RYAN, Scranton, chief of the American Red Cross in Belgrade, has been decorated by both the Serbian and French governments for his work in the hospitals where typhus fever has been raging.

DR. JOHN W. M. BUNKER, of the department of hygiene and sanitation, and sanitary in-

spector of Harvard University, has resigned to organize and direct the bacteriological research department of the Scientific Laboratories of the Digestive Ferments Co., Detroit, Mich.

E. S. Dickinson, formerly assistant professor of mining at the University of Kansas, has taken a position on the mining staff of the Canadian Copper Company at Copper Cliff, Ont.

Dr. L. H. Pennington, professor of forest pathology in the New York State College of Forestry, is spending the summer on the Pacific coast, where he is paying special attention to the work which the national government is doing in the control of diseases of forest trees on the national forests.

A monumental cross bearing the inscription "James F. Donnelly, staff physician, New York City, U. S. A," has been erected over the grave of Dr. Donnelly, who died while treating typhus fever in Serbia.

Dr. Thomas Stillman, the well-known chemical engineer, died of heart disease, on August 10, at the age of sixty-three years. Dr. Stillman was professor of analytical chemistry at the Stevens Institute of Technology for thirty-five years, retiring on a Carnegie pension in 1909.

Mr. H. S. Bion, assistant superintendent of the Geological Survey of India, died at Calcutta on June 6.

Mr. Herbert Kynaston, director of the Geological Survey of the Union of South Africa, died at Pretoria, on June 28, aged forty-six years.

Captain C. F. Balleine, fellow of Exeter College, Oxford, who had done work in archeology, was killed in Flanders on June 2.

Ernest Lee, lecturer in agricultural botany at the University of Leeds, has been killed in the war.

Dr. J. F. Eykman, professor of organic chemistry at Groningen, has died at the age of sixty-four years.

The death is announced of M. A. Arnaud, who occupied the chair of chemistry at the Museum of Natural History in Paris, and was distinguished for his work in chemistry and pharmacology.

Dr. Karl Kraepelin, formerly director of the Hamburg Natural History Museum, has died at the age of sixty-seven years.

The sixty-seventh annual session of the American Medical Association will be held at Detroit, June 12 to 16, 1916. The house of delegates will convene on June 12, and the scientific sections on June 13.

The petition of the Royal Astronomical Society has been granted, and a supplementary charter to permit the election of women as fellows and associates has been received. Proposals of women for admission as fellows can now be made.

Construction work on the new building of the Field Museum of Natural History, which is to be built on Chicago's lake front, just south of Twelfth street, began on July 15, after twelve years of planning and negotiation. The structure will be completed in less than three years, according to plans. More than 3,000 men will be employed in the work. It is said that it will be the largest marble building in the world and one of the largest museums. It will consist of three stories and a basement and will cover an area of 700×350 feet. The floor area of the museum will be 670,000 square feet, of which 400,000 square feet will be devoted to exhibition purposes. The remainder will be used for scientific laboratories, lecture halls, offices and a restaurant.

The children of William H. Singer, Pittsburgh, will erect a laboratory for investigations into the origin of disease, which will be operated in connection with the Allegheny General Hospital. The cost of construction, equipment and endowment will amount to $400,000.

Mr. J. S. Diller has been studying Lassen Peak on the ground in cooperation with officials of the Forest Service and has reported to the director of the geological survey as follows: "The great eruptions of Lassen Peak of May 20 and May 22 spent the energy of the old volcano and put a lid on it. The

effects of the flood on Hat Creek are being turned to good account, while many visitors are safely climbing the peak. Although it is possible that Vulcan is simply conserving his forces for a future outbreak, the general indications are that he is closing up the Lassen Peak branch of his laboratory for the season, perhaps with the intention of giving a small exhibit next spring when the snow melts."

UNIVERSITY AND EDUCATIONAL NEWS

DR. W. S. FRANKLIN has resigned from the professorship of physics in Lehigh University.

DR. JOHN LEE COULTER has been appointed dean of the College of Agriculture and director of the Experiment Station of the West Virginia University. He goes from the George Peabody College, and will take the place of E. D. Sanderson, who resigned about a year ago.

DR. OSCAR THEODORE SCHULTZ, formerly assistant professor of pathology in the medical school of Western Reserve University, has been appointed professor of pathology and bacteriology in the College of Medicine, University of Nebraska.

DR. JOHN N. SWAN has resigned his position in Monmouth College to accept the head professorship in chemistry in the University of Mississippi.

DR. E. L. TALBERT has been appointed secretary of admission in the University of Cincinnati, also giving the courses in social psychology.

JOHN JENKINS BUCHANAN, A.M., M.D., Ph.D., professor of surgery in the school of medicine, University of Pittsburgh, for the past fourteen years, has resigned his active teaching and has been elected professor emeritus. Robert Tablott Miller, A.B., M.D., for the past five years a member of the staff of the department of surgery of the school, lately holding the position of associate professor of surgery, has been promoted to the full professorship in charge of the department. Dr. Miller is a graduate of Amherst College and Johns Hopkins University Medical School. He held the position of resident on the surgical staff of the Johns Hopkins Hospital for a period of six years, following which he was elected to the position of instructor in surgery in the Johns Hopkins Medical School, which position he held for a period of two years, prior to his taking up his residence in Pittsburgh.

DR. J. R. SCHRAMM, assistant to the director of the Missouri Botanical Garden and instructor in botany at Washington University, has been appointed assistant professor of botany in the New York State College of Agriculture at Cornell University. Dr. Lester W. Sharp has been promoted to an assistant professorship in botany at the same institution. Other recent appointments in botany at the New York State College of Agriculture are as follows: J. Marshall Brannon, Albert R. Bechtel and Frank B. Wann, instructors; John P. Benson, Robert Stratton, Lawrence Erickson, George R. Gage and Harry E. Knowlton, assistants.

MR. HOWARD B. WAHA, who graduated in civil engineering from the Pennsylvania State College in 1909, and who has been employed in engineering work with the U. S. Forest Service in New Mexico and Arizona since graduation, has accepted the position of assistant professor of forest engineering in the New York State College of Forestry, Syracuse University.

W. A. ELLIS, a teaching fellow in the State College of Agriculture at Cornell University, has been elected instructor in forestry entomology. He will give his attention to insects affecting shade and forest trees of the state, and will assist Dr. M. W. Blackman, forest entomologist of the college.

PROFESSOR R. ROBINSON, of the University of Sydney, has been appointed to the newly constituted chair of organic chemistry at the University of Liverpool.

DR. HANS REICHENBACH, professor of hygiene at Göttingen, has declined a call to Halle.

DISCUSSION AND CORRESPONDENCE

PUBLIC HEALTH IN AMERICA

TO THE EDITOR OF SCIENCE: I was much interested in the article by Dr. W. W. Ford,

"The Present Status and Future of Hygiene or Public Health in America," read at the May, 1915, meeting of the Association of American Physicians, and published in Science, July 2, 1915. His presentation of the subject is an interesting exposition of the medical viewpoint and bias in public health, but many of his statements are dogmatic assertions, and are highly debatable; others are inconsistent with each other. For example, compare (page 11, column 1)

> . . . every medical school in this country should have its department or institute of hygiene. . . . It makes little difference whether the head of this department is a chemist, a bacteriologist or a physicist, since the problems of hygiene must be approached from various angles . . .,

and (page 11, column 2):

> It is essential that hygiene be presented as a distinct and independent science and not as a phase of bacteriology, or of chemistry, or of physics,

with (page 11, foot of column 2),

> Above all it must be remembered that hygiene is a medical subject and a part of medicine. Its methods are the methods of medicine . . .,

and with (page 12, column 2),

> . . . the health officer, be he city, county or state, has a distinct function, the intelligent exercise of which requires a medical training.

Surely if chemists, bacteriologists and physicists are competent to teach hygiene or public health (which is debatable), they should be competent to practise it; obviously if public health or hygiene is admitted to be a distinct and independent science, it can not be in the same breath a mere subsidiary of medicine.

Some of the main points in Dr. Ford's article must here go unchallenged for lack of space, but before proceeding to my main statement I wish to take up one minor point. He states (page 10, near bottom of column 2):

> The indifference to hygiene as a science lies in our universities and in our medical schools, and the responsibility for the failure of its development rests squarely upon them.

This is at least partly true, unless we wish to quibble as to whether public health is a science or the application of facts and principles of science. But the failure of the *practise* of public health rests squarely upon the medical profession. Led astray by idealism and zeal for the public welfare (some of the finest traits of the profession as a whole), they have offered their services as health officers in this country too often either without compensation or with very inadequate compensation. This has had a bad effect upon the public mind. Rightly or wrongly, the public tends to value things or services in proportion to the price they pay. This unselfishness by the profession will retard the development of public health in the future, as it has in the past, by making the public unwilling, until educated, to pay well for full-time technically trained health officers when they are able to get part of the time of an untrained practitioner-health-officer at nothing or next to nothing.

As has been well said before, we have heretofore chosen practitioners of medicine as our health officers because they came nearest of any class in the community to having the qualifications necessary for the work. As a matter for argument, I submit that practitioners of medicine lack much of the fundamental training and knowledge required for public health work, and some of their training and qualifications, except in unusual men, actually unfits them for true public health work, in part for the following reasons:

1. Public health is a function of government, not an appendage to the practise of medicine.

2. Public health is a distinct entity, an application of the facts and principles of various fundamental sciences to the *maintenance of health* and the *prevention of disease.*

3. Public health must be based on the facts of health and disease in the mass (in numbers, space and duration of time); the practise of medicine mainly upon individual cases.

4. The practise of medicine is an individual endeavor for private gain derived from individuals in a community; the practise of public health is a public endeavor by and for

the community, and paid for by the community.

5. Medical practise combined with public health service is an incompatibility.

Recently it has been argued that the training and experience of the sanitary engineer qualify him for public health work. As a matter of fact much of the sanitary engineer's training is exceedingly valuable in public health work, but the sanitary engineer as such is certainly no more qualified than the physician. The fact that several sanitary engineers have proved successful as administrative health officials by no means proves that the training of the sanitary engineer is the ideal foundation for public health work. The same arguments that have been presented for the sanitary engineer might be advanced for the training and qualifications of the attorney, the statistician, the chemist, the bacteriologist, the parasitologist, the veterinarian or the sociologist. All have labored in the field of public health, and all have at least some qualifications of great value.

Public health is now casting off the swaddling clothes of its infancy, and entering upon a period of vigorous youth. Medicine has been one of its parents, but now that the child is endeavoring to travel its own path we hear that parent uttering warning cries and, like all good parents, prophesying immediate or ultimate disaster if its rules and precepts are not heeded. For example, witness Dr. V. C. Vaughan's statements before the 1915 convention of the American Medical Association in San Francisco, and Dr. Ford's paragraph at the top of column 1 on page 13. We have heard several such utterances lately. Some we may suspect of having ulterior motives behind them; others, as the ones referred to, are admittedly cries of alarm on the part of the medical profession at the prospect of a fancied loss of prestige and influence.

In the last analysis the highest type of public health official will be a statesman, an administrator, an educator, above all an efficient public executive. He will have a broad public vision, partly from native qualifications, but developed by a broad training in public health *as such*, which will include much that is in medicine, but leave out much of medical training; which will include all that is essential in sanitary engineering, law, sociology, and the various fundamental sciences such as chemistry, biology, bacteriology, etc. He will also have an excellent foundation of general culture. He will superintend the work of physicians, engineers, statisticians, chemists, bacteriologists, attorneys, veterinarians and the like employed for special limited but intensive fields in public health, and will be the guiding hand in shaping public policy with respect to health. His life work, training and ideal will be public health, not private practise with public health on the side.

I realize that in thus criticizing some of Dr. Ford's statements I also have relapsed into dogmatic statements. This is difficult to avoid in the brief space of a letter, where proof would require a volume. I hope, however, that I have been able to show that certain viewpoints and theories in public health are debatable, and to have presented briefly a different, and I hope a better viewpoint.

HAROLD F. GRAY

BOARD OF PUBLIC SAFETY,
PALO ALTO, CAL.

THE ATTITUDE OF THE STATE OF CALIFORNIA TOWARD SCIENTIFIC RESEARCH

THE note on the Scripps Institution for Biological Research which appeared in SCIENCE, June 18, 1915, contains the statement that the state of California contributes $7,500 a year toward the support of the institution.

This should be amended to the extent of saying that at the last session of the legislature, which adjourned a few weeks ago, the contribution was increased by $5,000, thus making the income of the institution from the state after July 1, 1915, $12,500 a year.

This discrepancy in statement is too small a matter to be in itself worth noticing, but as indicative of the attitude of the state toward the institution and toward scientific investigation generally, it is quite deserving of notice.

Two years ago when the first allotment was made by the state to the university for the

institution, and this year when an increase was asked, representatives of the state in both its legislative and executive branches charged with the task of preparing the budget for maintaining the state institutions during the ensuing biennium visited the institution, went over with the scientific staff and business manager in considerable particularity the work being prosecuted, and were unequivocally assured that the problems under investigation are all first and foremost scientific, and that only some of them might be expected to have a money value to the state.

Great emphasis was, however, laid by the men of the institution on the two facts that all increase of knowledge of nature is capable of being made useful to the people of the commonwealth in one way and another, either for their enlightenment or pleasure or material gain; and that the institution holds itself under as much obligation to make its discoveries utilizable in some form, as it does to prosecute the investigations themselves.

The attempt has always been made to impress upon officials and public that this institution is one in which private benefaction wishes to join with state benefaction for serving the community through *research in pure science.* And it is pleasant to record that the officers of the state government have been found to be at least not less responsive to the appeals for financial aid than have been the president and regents of the university.

Mr. John F. Neylan, chairman of the state board of control has taken the pains to expressly state that the placing of the institution's item specifically in the allotments to the university, which allotment is in turn a permanent element in the state budget of running expenses, should be understood to mean that the state accepts the institution with its avowed commitment to research as a definite and perpetual charge upon the state. And from Mr. H. W. Wright, chairman of the ways and means committee of the last assembly, comes the declaration: "We recognize that the state must support institutions of this kind."

From what California has done toward maintaining the Lick Observatory through a considerable term of years, and is now doing for the Scripps Institution, the conclusion seems justified that the state is definitely committed to the principle of state aid to scientific research, even though such research has no direct and primary industrial aims. In discussing these matters with officials, I stoutly contend that in the long run about the most telling criterion of success of popular government will be the extent to which it contributes to the highest development, spiritual and physical, of the naturally best endowed persons who live under and who participate in such government. The facts and reasonings that can be presented in support of this proposition, particularly those touching the question of leadership in scientific discovery, seem to appeal with special force to men grappling earnestly with the practical problems of government for a modern community.

Experience strongly inclines me to the view that the serious derelection of our national and several state governments in the support of scientific investigation is chargeable quite as much to scientific men themselves as to government officers and the people at large.

Wm. E. Ritter

La Jolla, California

A REPLY TO DR. LITTLE

If we are ever able to discover what part hybridization plays in evolution, it is immeasurably more valuable to find out the behavior of natural species rather than of forms created in the laboratory under more or less artificial conditions, and which are never found outside the laboratory. This effort to place hybridization among evolutionary causes has been one of the chief aims of students of heredity.

My repetition of the standard cross between grays and albinos to discover the behavior of coat color in mice was carried on with wild housemice and not with artificial laboratory grays.

It is still open to question whether the wild housemouse (*Mus musculus*) inevitably fur-

nishes actual "homozygotes" which will stand every test of the theoretical "homozygote." Tower's work with chrysomelid beetles gives him pure-breeding species which behave as homozygotes in one hybrid cross with other pure breeding species, and as heterozygotes in other such crosses; and this order controlled environmental conditions never equalled in experiments with mice.

Moreover, the assumption of the exact similarity of every first generation hybrid in a given cross with respect to a given "unit character" leaves no place in nature for variation in any "unit character." Variation therefore would become wholly a matter of environment.

The divergence from the accepted canon of my results of color transmission in crossing wild housemice with laboratory albinos, involves a difference of data which in no way affects the question of the transmission of cancer.

Moreover, it is increasingly difficult to know the established canon in the behavior of characters in heredity. Exceptions to what was the canon have become so numerous as to be a part of the rule; and Riddle's work on melanin formation makes it particularly dangerous to be dogmatic on the transmission of such pigmentation in heredity, particularly in mammalian species where pigment is melanin.

My attack upon the problem of the inheritability of cancer was made almost with the sole end of solving the practical questions as to its inheritability and its nature, in order that we might get light upon the methods for its prevention and its cure, since these facts are so desperately needed.

In the face of the tremendous difficulties which the study of these things involve, it is essential that all minor considerations should be laid aside. It is essential also that the presentation of results should be simplified as much as possible and be kept as free as they can be from the disputes involved in the study of general problems in heredity. These details are not desired by the two classes most concerned, viz., humanity, who suffers from cancer, and the medical profession who must deal with it.

My practical results in the matter of the inheritability of cancer are these:

1. I have established strains of mice which neither in inbreeding nor in crosses with other noncancer-bearing strains ever in any generation have produced cancer.

2. I have made hybrid crosses between cancerous and non-cancerous individuals and have extracted from such crosses lines of mice which neither in inbreeding nor in hybridization with other non-cancer-bearing strains of mice have ever afterward shown cancer.

3. I have produced a cancer strain in which every member (of a reasonable cancer age) still living after my cancer work began bred true to cancer, and carried it into every strain with which it was ever hybridized.

4. I have extracted from crosses between cancerous and non-cancerous mice, lives which produce as high a per cent. of cancer-bearing individuals as it is reasonable to expect in dealing with a characteristic like cancer which may not appear until a mouse is three years old or even more. Many of these mice in cancer strains inevitably die of other causes before the right provocation has induced cancer in them. But the hybridization test has shown them cancerous potentially, for they transmitted it to their offspring.

This test, of course, has not been made with every individual. To subject every individual in every strain to every test is obviously impossible. The best one can do is to make a reasonable number of such tests, the object being to give to the medical world as quickly as possible the evident facts.

The production of about a thousand spontaneous cancers in specified strains, and the non-occurrence among this entire number of any cancer in certain other specified strains, no matter what test is applied to them, demonstrates to every reasonable probability the inheritability of cancer, and when these results are characteristically and systematically obtained in such an immense stock as to furnish over ten thousand autopsies and a living stock of about eleven thousand mice, with a steady production of between seventy-five and a hun-

dred cancer patients all the time and almost without exception within proved cancer strains, this reasonable probability is raised to an almost indisputable fact; and whether or not my strains of housemice have behaved in hybrid crosses in accordance with the established canon has no bearing whatever upon the behavior of cancer. It is an academic dispute which lies in quite another field.

In regard to my use of the terms "dominant" and "recessive" with respect to cancer behavior: it is almost the established conviction to-day that these terms are descriptive and not dynamic, and they furnish in the description of the behavior of cancer in heredity a graphic and convenient tool. That is probably all they furnish in the exposition of any problem in heredity. They may be discarded for even that service within the next few years.

The chief value in the study of cancer of the use of a partial Mendelian background of comparison (although the details may be under dispute) is to show to those most interested how far back in a strain cancer may lie and still be transmitted, and by what sorts of crosses this can be done, and to make it plain that in deciding upon the inheritability of human cancer and of the method of elimination of cancer from a family, one can not take as a criterion of judgment whether or not the immediate parents exhibited cancer.

I do not desire or make a strict Mendelian interpretation of my results, indeed I should deplore such an interpretation. I have used Mendelian comparisons (1) to make clear the influence of a more or less remote ancestry upon later generations of progeny; (2) to show how cancer, like albinism, has been transmitted in my strains through generation after generation by individuals who did not exhibit it; and (3) to demonstrate how cancer thus transmitted finally leaps into expression in the offspring of a pair neither of whom expresses cancer, but both of whom bear it potentially.

The approximation to even the most conservative Mendelian expectation is strikingly close for such a characteristic as cancer.

Maud Slye

The Otho S. A. Sprague Memorial Institute

SCIENTIFIC BOOKS

The Mathematical Theory of Investment. By E. B. Skinner. Boston, Ginn and Company, 1913. Pp. ix + 245.

Skinner's Theory of Investment is divided into four parts: 1. Algebraic Introduction. 2. Interest and Annuities. 3. Probability and Its Applications to Financial Problems. 4. Tables.

The Algebraic Introduction gives a sketch of arithmetic and geometric progressions, limits, series in general (with particular emphasis upon the binominal, exponential and logarithmic series), logarithms and graphical representation.

In the discussion of Interest and Annuities, the old standard problems are taken up, including such applications as amortization, the valuation of bonds, sinking funds, depreciation, building and loan associations.

In the third part a short introduction to the theory of probability precedes the discussion of life annuities and some other problems in life insurance.

There are 12 tables, mostly 7 place, for dealing with interest (simple or compound), discounts, and present values, annuities, and life insurance data.

This work is elementary, clearly written and satisfactory throughout for a general introduction to the problems with which it deals. In regard to insurance, one finds just about enough for an introduction without too much to take the cream off a real course in insurance. The subject of interest and annuities, however, is handled in such detail that further work upon the subject might not be needed.

The work is entirely formal, that is to say, no reference is made to economic conditions which affect the real rate of interest. The question, for instance, of the price level is not mentioned. No theory of interest can be other than mere form, without substance, apart from a discussion of the effect of a change of price level upon the investment yield, both as to principal and interest.

In discussing the valuation of mining properties the author says: "When a sum of money is loaned the person making the loan not only receives interest at a stipulated rate at the

end of each year, but at the end of a stated period he receives his original capital back again in full. There are, however, some forms of investment where the original capital is not returned to the investor. In such cases provision must be made for the redemption of the capital by setting aside some portion of the annual income as a redemption fund. A mine is a typical form of investment," etc. Now there is very serious objection to all this great detail and clearness on a subject which is not at all clear. You can not value a mine properly unless you know the price at which the product will be sold, and even then unless you know the amount of ore the mine contains, and the difficulty or ease of mining it. The impression is given that the mine will run out; what justification have we for such an impression? In the case of porphyry deposit of copper, where the total tonnage can be properly estimated, we can perhaps undertake to find some value of a mine. In the case of vein mines, however, there is no such possibility. Some mines have been worked for hundreds of years and are apparently richer to-day than ever before (Tintos, for example).

Moreover may it not be the rule rather than the exception that capital is not returned?

The average price level has risen so rapidly in the last fifteen years that a person who put his money out on loan fifteen years ago and received it back now, would have, in purchasing power, not more than one half to two thirds of that which he loaned. For the author, he would have his original capital back in full. From an economic point of view, he would have a very highly depreciated capital returned to him. He would be no better off than if he had invested in a mine, that was a mine, fifteen years ago—probably much worse off.

We realize fully that it is not in the province of the elementary book which Skinner has written to go into every sort of detail in regard to investments, but it does seem to us as though a short account of the bearing of the major economic phenomena upon investment should be included.

EDWIN BIDWELL WILSON
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Prehistoric Man and His Story. By PROFESSOR G. F. SCOTT ELLIOT. London, Seeley, Service & Co., 1915. Pp. 16, 398; illustrations and diagrams 64.

This is the second book by British authors on the general subject of prehistoric man to appear in 1915. The present volume however differs so widely from the one by Sollas that there is room for both. Besides the work by Elliot includes chapters on the neolithic period and the age of metals. Both agree in devoting much space to a comparison between prehistoric archeology and the ethnology of living primitive races.

In the initial chapter, on the preparation of the earth, it is pointed out that remains of lemurs have been found in the Eocene of North America and Europe, and the question is raised whether a "generalized lemur-monkey-man" could have lived at the time. If so he could have wandered all over the northern hemisphere from San Francisco to New Jersey, also from England to Japan. The climate was warm but not oppressively hot. As to food the land would have been considered a paradise by any living primitive race. The Miocene descendants of the common Eocene ancestor would have had to contend with carnivorous animals.

A discussion of "*Homosimius precursor*" naturally leads to the question of eoliths. These are flints of various ages which "have certainly been struck or chipped in an unusual way." While it is still not possible to say whether (or not) they were utilized by man, the author believes the evidence in favor of the artifact nature of some of the eoliths is more weighty than that to the contrary.

The next three chapters are devoted to missing links, the human body, and the limit of humanity. As one might expect, comparison of the brains of apes and of men shows considerable differences; on the whole, however, the general likeness is more striking than the contrasts. The differences between man and his Pliocene ancestor is "clearly in brain rather than in eyesight or manual dexterity."

The author is a monogenist and also adheres to the orthodox belief that the Old

World was the first home of man. There he invented his first tools and became acquainted with the use of fire. How were the first grass and forest fires produced; by a flash of lightning or a lava flow? Perhaps! but this can not have been a common origin, for the lightning is usually followed by heavy rain. Early man would flee from volcanic eruptions and run to some secluded spot during a thunderstorm. Neither occasion would be suitable for first experiments in the use and control of fire. Theobald states that forests in southern India are often set on fire through friction produced by one bamboo branch rubbing against another. It is likewise known that the Negritoes of Zambales still make fire by rubbing one bamboo across a nick in another. This was probably the first method employed by early man in the production of fire. The discovery of how to make fire came early and like the advent of the tool-using habit in general had a profound influence on the subsequent fortunes of mankind. How long ago these momentous steps were taken is not definitely known. The author thinks it might have been as far back as Pliocene times.

The rather short chapter on the glacial epochs is supplemented by a chronological table, from which it is seen that Elliot differs widely from Sollas. He accepts the Penck system of four glacial epochs with alternating warm episodes and would place the first known Europeans, *Eoanthropus dawsoni* and *Homo heidelbergensis,* in the first of these interglacial epochs, viz., the Günz-Mindel (Penck and also Obermaier would place them in the second). The Chellean, the first cultural epoch, eoliths excepted, is for the author synchronous with the second or Mindel-Riss interglacial epoch. In this he agrees with Penck and Geikie; but differs from Obermaier and Sollas who believe that the Chellean belongs to the third interglacial epoch (Riss-Würm). The differences of opinion appear still more pronounced when the attempt is made to express length of time in terms of years. For Sollas the Chellean epoch closed only about 27,000 years ago. This same lapse of time the author would estimate at more than 150,000 years.

In discussing the races subsequent to that of Neandertal, the author's statements are liable to confuse the reader. On page 121 he states that the "Aurignacians seem to have lived on in Europe through the Würm Ice Age, becoming in course of time the Magdalenians (or race of Cromagnon)." On page 163 he likewise speaks of the Cromagnon people as Magdalenian ("Madeleinian"). But on the following page one reads: "Yet the Aurignacians, or men of Cromagnon, were a primitive people," etc. Again on page 177 the race of Cromagnon is called Aurignacian.

In that part of the book devoted to paleolithic man, the use of such titles for chapter headings as "The First Herdsmen" and "The First Harvest" might lead the unwary to suppose that the domestication of animals and plants was a paleolithic achievement. The author does not think there is a "single paleolithic engraving of any of the cat tribe." Such engravings are rare but they are not unknown. On page 297 one is led to infer that the 840 basketry patterns of the Pomo Indians of California are prehistoric.

Letters, numbers, weights, etc., come in for interesting treatment, the conclusion being that not only the cup-and-ring marks but also a whole series of letters, number-signs, and others were handed on from the paleolithic to their neolithic successors; and that perhaps it is to the paleolithic period that we have to look for the origin of reading, writing and arithmetic.

Of the twenty-four plates, ten are from Rutot's reconstructions of early races; and twenty-two of the thirty-eight text-figures are from *Childhood of Man* by Frobenius. Useful references and footnotes are assembled at the end of each chapter. The author has read widely and traveled extensively. The transmission of his experiences is aided by a luminous imagination. If he has a fault it lies in a too-ready apparent acceptance of data, the value of which is still in the realm of the uncertain.

George Grant MacCurdy
Yale University

NOTES ON METEOROLOGY AND CLIMATOLOGY

CLIMATIC PROVINCES OF THE PACIFIC COAST

THE primary control of the Pacific coast climates rests with the ocean and the almost continuous westerly winds. Since the ocean has practically the same temperature all along the coast, the north and south temperature gradients on land are gentle. On the other hand, the mountain ranges paralleling the coast bring about sharp transitions in an east-west line—so that in summer one may pass in a few hours from the cold coast to a hot interior valley. The ocean, the west wind, and the mountains, thus, make the climatic provinces into belts roughly parallel to the coast. These belts may be subdivided on the basis of rainfall, which decreases rapidly from north to south. Mr. W. G. Reed has ably discussed and mapped such a distribution of climatic provinces in the January, 1915, *Bulletin of the American Geographical Society* (pp. 1–19, 4 figures). The classification in abstract is as follows:

I. Pacific Province, marked subtropical winter rains, dry or nearly dry summers.
  1. California District, dry summers, infrequent winter snows.
    a. Southern California Region, dry summers 3–4 months long, annual rainfall less than 20 inches.
    b. Central California Region, dry summers 2 months long, annual rainfall 10–30 inches.
    c. Northern California Region, annual rainfall more than 30 inches.
    d. Sierra Region, annual rainfall greater than the central region, much snow.
    e. Tulare Region, annual rainfall less than 10 inches, largest temperature ranges in this district.
  2. Oregonian District, light cyclonic summer rains.
    a. Coast Region, heavy annual rainfall.
    b. Valley Region, least annual rainfall of district.
    c. Cascade Region, intermediate rainfall, more snow than elsewhere in district.

II. Rain Shadow Area, large diurnal and annual ranges of temperature and generally deficient precipitations.
  3. Great Basin District, high maximum temperatures, annual rainfall generally less than 10 inches.
  4. Snake River District, annual rainfall 10–20 inches, sub-Pacific type of distribution.

EFFECT OF CLIMATE ON LOCATION OF MANUFACTURING PLANTS

A PAPER on this subject read by Mr. W. M. Booth at a meeting of the American Institute of Chemical Engineers appears in abstract in the *Scientific American Supplement* for April 3, 1915 (p. 219). The principal manufacturing belt of the United States is located north of the regions where summer heat interferes much with indoor work, and south of the areas blocked by heavy winter snows and hampered by frozen waterways. Within this belt specific climatic conditions may determine the distribution of certain industries. For instance, the manufacture of enameled leather is dependent on sunshine. Atmospheric dryness is an advantage where hygroscopic articles, small steel parts, and other things injured by moisture are manufactured or packed. On the other hand, moist air and equable temperature are desirable for the successful manufacture of linen, cotton, jute and hemp. This accounts for the importance of Fall River, Providence, Lawrence and Lowell as cotton mill centers. Similarly, some of the Pacific Coast cities may become textile centers when labor and markets permit. Adverse climatic conditions may be artificially overcome where other factors make the business sufficiently profitable.

CLIFF DWELLINGS AND CHANGES IN CLIMATE

FROM the abundance of abandoned cliff-dwellings in the Navajo Country of the arid southwest, it might be assumed that there was once a rainfall capable of supporting a popula-

tion much larger than the present. Professor H. E. Gregory at the joint geographical meeting in New York (April 9–10, 1915) has pointed out that the Hopis who built the cliff-dwellings are migratory and frequently abandon a village after having lived in it some years. Therefore, the numerous abandoned villages do not necessarily indicate a larger population and a climate more moist in the later prehistoric times.

THUNDER AND LIGHTNING

Dr. Wm. Schmidt, after many observations with his thunder-recorder, finds[1] that we hear but little of the air vibrations produced by lightning. Thunder is accompanied by irregular pressure changes lasting 1/40 of a second or more and some only 1/75 to 1/120 of a second. The periods of most of the longer pressure waves are 1/10 to 1/3 second—too long for ear perception. Much of the mechanical injury done where lightning strikes is probably due to these waves. From a distance one violent wave comes first, then follow perhaps two or three series of three to four heavy waves each. On account of atmospheric action on irregular waves the thunder becomes of more or less definite pitch. Dr. Schmidt has inferred that at the source the lightning energy may be five million times as great as that of the thunder it produces.

Insurance statistics from both Canada and the United States show the efficacy of lightning rods in keeping buildings from taking fire if they are struck.[2] In Ontario, taking equal numbers of rodded and unrodded farm buildings, twenty times as many of the latter as of the former were struck. In the United States in 1912 and 1913 two hundred insurance companies reported 1,845 buildings struck, of which but 67 were rodded. Considering that 31 per cent. of all buildings insured were rodded, the lightning rod efficiency is thus 93 per cent. Furthermore, the reports of five companies for a period of 13 to 25 years on 18,000 buildings insured, over 50 per cent. being rodded, showed that the average damage of the struck buildings was $10 for the rodded and $2,200 for the unrodded.[3]

According to the best European data, the maximum period for thunderstorms is from 3 to 5 P.M., while the minimum falls just after midnight and from 7 to 8 A.M. The month of greatest frequency is June and those of least are December and January.[4]

Of the 4,520 fires reported on the national forests in 1913, 1,571, or about 35 per cent., were ascribed to lightning.

NOTES

An unseasonal northeast snowstorm accompanying an intense tropical cyclone visited the Atlantic coast on April 2, 1915. Snow fell from Georgia northward, the heaviest about ten inches being recorded around Raleigh, N. C., at the head of Chesapeake Bay, and on the New England coast. The inland extent was generally less than 200 miles; in the north the railroads reported Utica, N. Y., Woodsville, Vt., and Kineo, Me., as the limits. Raleigh, N. C., seems to have suffered most, being without outside telegraphic communication for five days. In other districts traffic was hampered. The snow melted very rapidly and with little or no runoff, owing to the extremely dry conditions of the soil after an almost rainless March. Thus agriculturally this snowstorm was of great value.

On May 1 the British Meteorological Office ceased issuing forecasts except to farmers. This was thought necessary because the forecasts might be of value to the Germans.

The announcement for the 1915 international kite and balloon flights came from the Nicholas Central Observatory at Petrograd instead of from Strassburg as heretofore.

[1] *Monthly Weather Rev.*, December, 1914, pp. 665–671; *Scientific American Supplement*, March 13, 1915, p. 175.

[2] See *Scientific American*, November 28, 1914, p. 347, and April 3, 1915, p. 303.

[3] See also J. Warren Smith, "Efficiency of Lightning Rods," *Ohio Naturalist*, Columbus, O., February, 1915, pp. 437–442.

[4] J. von Hann, "Neue Beitrage zur Kenntnis der taglichen Periode der Gewitter," *Meteorologische Zeitschrift*, February, 1915, pp. 73–82.

Since the closing of the Mount Weather research observatory last winter, the Blue Hill Meteorological Observatory is alone in the United States in regularly flying kites in the international days. However, the Weather Bureau is planning to resume aerological work at Omaha.

A MAP of the eastern United States showing the frequency of dry spells during the last twenty years in the months of April to September inclusive was published in the National Weather and Crop Bulletin, May 4, 1915. The greatest frequency is found in the Great Plains district and the least in the southern Appalachians.

DR. W. KÖPPEN, after study of the monthly period in the weather[5] has come to the conclusion that the moon has no noticeable influence on meteorological phenomena.

A KNIGHTHOOD has been conferred on Dr. W. N. Shaw, director of the British Meteorological Service.

MR. AKSEL S. STEEN, who recently succeeded Dr. Mohn as Director of the Norwegian Meteorological Institution, died in Christiania on May 10.

A NEW departure in the distribution of weather forecasts is announced from Illinois where a newspaper man and the Springfield Watch Co. send out the predictions by wireless telegraph.

CHARLES F. BROOKS

WASHINGTON, D. C.

SPECIAL ARTICLES

ON THE REPRODUCTIVE AND HOST HABITS OF CUTEREBRA AND DERMATOBIA

IN view of the considerable mystery surrounding the host habits of *Dermatobia hominis,* the man-infesting bot of tropical America, now believed to employ bloodsucking mosquitoes of the genus *Janthinosoma* for the carriage of its eggs to the host, the following recently discovered facts relating to the reproductive habit of *Cuterebra* will be of interest, since *Dermatobia* belongs to the same restricted group of flies.

On June 25, 1915, Mr. Raymond C. Shannon, of the Bureau of Entomology, found a female *Cuterebra cuniculi* on the stem of a plant in a low moist spot near a stream in the vicinity of Beltsville, Maryland. The fly was inactive, and had probably recently emerged from the puparium. It was kept alive until July 2, 1915, when it was seen to be growing weak, whereupon it was killed and dissected.

The uterus was found to be of the double-sac incubating type, much after the style of *Sarcophaga,* probably independently developed in the Cuterebidæ and not indicating any close relationship with the Sarcophagidæ. The uterus was estimated to contain well over five thousand eggs and perhaps nearer ten thousand. It is difficult to make a close estimate, as the eggs are disposed in bunches at various angles to each other and the two large sacs which constitute the uterus are irregularly rounded.

The egg is elongate, about 1.75 mm. in length, about .4 mm. in greatest width, gently tapering toward the caudal end, suddenly tapering at the cephalic end, with tough extra-thick and strong reticulated chorion of a deep salmon color, and is furnished with an operculum or lid on one side at the cephalic end. The lid hinges by its cephalic edge, but is easily completely detached. The chorion appeared to be particularly viscid at and near the caudal end. The embryo was undeveloped. The tubular glands are large and evidently functional, and contained a deep rufous-yellow substance. The ovipositor is simple and without any piercing structure.

The presence of the incubating uterus, enveloped with tracheæ, indicates that the egg is held within the fly until the maggot is well formed. The presence of the thick chorion indicates that the maggot is ejected still ensconced within the shell, or that practical oviposition takes place. The simple structure of the ovipositor shows that the egg is not thrust through any integument or surface. Moreover, the fact that the chorion is tough, extra-strong and deeply colored indicates that

[5] Concluded in *Meteorologische Zeitschrift,* April, 1915. Translated in *Monthly Weather Bureau,* April, 1915, pp. 179–181.

the maggot remains quiescent therein exposed to the conditions of the open for more or less time after the act of oviposition. The high viscosity of the caudal end of the chorion indicates that the egg is firmly attached by that end to some surface, where it remains permanently. The high fecundity indicates a high mortality of the first-stage maggot, a reduced chance of reaching the host, and hence presupposes that the egg is not deposited on the host nor on any object that will be certain to come in contact with the host. The operculum at cephalic end indicates that the maggot, on being awakened from its quiescent state, immediately escapes by that exit. A normal excitement of the maggot to activity can be induced only by the heat resulting from close contact with the body of a warm-blooded host animal.

As far as *Cuterebra* is concerned, we can feel quite confident that its host relation is maintained through stealth, and that, barring accidents, the fly never comes in contact with the host. The eggs are probably deposited in the burrows or runways of the rabbits, rats and other small mammals which it parasitizes. I have found these flies in considerable numbers in the southwestern mountain regions of North America, where they uniformly either perch on dead twigs beside a stream or sit on rocks near the running water or on the earth banks of streams. They evidently take such stations in order to observe the movements of rodents, with a view to locating favorable places for oviposition. Their small antennæ indicate a poor sense of smell, while their large and finely-facetted eye-surface indicates good sight.

Dermatobia parasitizes not only man, but many of the larger mammals. Such animals do not live in burrows or frequent regular runways or places of concealment. Thus *Dermatobia* can not hope to reach its hosts by employing the methods of *Cuterebra*. It has a much smaller fecundity, less than eight hundred according to Neiva of Brazil, which indicates that it adopts some method much more apt than that of *Cuterebra* to connect with the host. Its maggots are very common in cattle, dogs and man in South and Central America, yet among the natives no one seems able to identify the fly that deposits the egg. The indigenes of South America accuse a variety of dipterous insects of mothering these maggots.

Within the past decade, observers in Central and South America have discovered a number of instances of mosquitoes, uniformly of the genus *Janthinosoma*, bearing a cluster of *Dermatobia* eggs attached by their ends to the under surface of the body. Apparently the credit for the first discovery of this kind belongs to Mr. F. W. Urich, government entomologist of Trinidad, who sent one of these egg-laden mosquitoes to Washington in 1905. The importance of the matter was not suspected at the time, and the specimen can not now be found. More recently Gonzales-Rincones observed the same thing in Venezuela, and inferred that the eggs were originally deposited on the leaves of plants frequented by the *Janthinosoma*, which gathered them up while walking about. His observations and conclusions were published and endorsed by Surcouf, of Paris.

In the absence of information to the contrary, we are justified in supposing that *Dermatobia* has a reproductive system and egg much on the same practical order as those of *Cuterebra*. Being unable to maintain its host relation in the same manner as *Cuterebra*, and being similarly unable to approach its hosts without unduly alarming them, since both flies are heavy-bodied and noisy in flight, it must necessarily resort to some extraordinary device for accomplishing its purpose.

Judging from the accounts of both natives and foreigners who have been infested with *Dermatobia* maggots, several distinct species of blood-sucking diptera may be employed by the fly for carrying its eggs. Mr. J. C. Crawford, of the U. S. National Museum, during a stay in Costa Rica, was actually bitten by some fly, and a *Dermatobia* maggot resulted at the point of biting. He also relates a case of an American in that country who stated positively that a *yellow* fly annoyed him in numbers on one occasion, crawling beneath his clothing. Afterward some two dozen *Dermatobia* maggots

developed in the region of his chest, where the flies had gained access. This suggests *Chrysops,* the members of which are commonly called deer-flies, and it is extremely likely that this genus may act as egg-carrier for *Dermatobia* quite as frequently as do mosquitoes. It should be stated that the *Dermatobia* flies are not yellow, but of a dark metallic green.

As to the exact modus operandi in the case of *Dermatobia,* it is quite certain that oviposition on foliage is not practised, but that the fly captures the elected carrier and holds it while gluing the eggs firmly by their caudal end to the underside of its body, leaving the cephalic end of the eggs free and in such position that it will come in immediate contact with the skin of any animal bitten by the carrier. Once the carrier alights on a warm-blooded animal, the heat of the latter's body causes the maggot to spring the lid of the chorion and to work its way immediately and doubtlessly very rapidly into the skin, most probably by way of a hair follicle. As suggested by Mr. Crawford, it is practically certain that the empty chorion remains attached to the carrier after the exit of the maggot.

CHARLES H. T. TOWNSEND

U. S. NATIONAL MUSEUM,
July 3, 1915

RAPID METHOD OF COUNTING BACTERIA IN MILK[1]

THE satisfactory control of milk supplies would be facilitated by a rapid method of determining the bacterial content. There can be no question but what the most accurate count is obtained by incubating plate cultures for five days at room temperature, but, in spite of this, two days at 37° C. is the only standard method. This has been adopted because of the urgent demand for a quick answer. Because of the advantage of obtaining results rapidly, the direct microscopical examination of milk is frequently urged. In spite of the obvious weaknesses of this method, such as the errors in measuring the small quantities needed or in centrifuging, and the fact that dead bacteria can not be differentiated from the living, this method has its earnest advocates.

If it were possible to use easily measurable quantities of milk, *i. e.,* from 1/10 to 1 cc., and grow the germs contained therein so that only those capable of forming colonies would be counted, and if this count could be obtained within, say, six hours, the demands in the case would be reasonably met.

If such an accurate count could be obtained in a few hours, it would be possible for the producer or dealer to determine actually the bacterial content of his product before putting it on the market. This would also enable the health official to hold a sample of milk suspected of being beyond the limits permitted until the count could be actually obtained, when the samples in question could be either passed or justly condemned. Under present conditions, when the bacteria are determined by ordinary cultural procedures, such a course is out of the question because it is not possible under any conditions to obtain a count in less than forty-eight hours.

It is possible now to suggest a rapid method, which, I believe, will meet any reasonable demands. The method is a combination of the direct count and the culture methods and is obtained by making small plate cultures on a microscopic slide. These little plates are incubated for several hours (three to six), then the medium is dried down and stained so as to bring out in sharp relief, when examined under the microscope, the minute colonies which have developed.

It is not proposed to go into definite details in this preliminary paper[2] but rather to define the lines along which the investigation is proceeding. In explanation of the methods, however, it may be said that about one tenth of a cubic centimeter of milk is mixed with standard agar and spread over a definite area of a sterile glass slide. When the agar is hard, this little plate culture is put in the incubator for about six hours, under conditions which prevent evaporation. It is then dried, given

[1] Preliminary note. Publication authorized by the Director of the Wisconsin Experiment Station.

[2] An extended account of the method and the results obtained in a series of analyses will soon appear.

a preliminary treatment to prevent the agar from firmly binding the strain, stained, decolorized and cleared. When this dried and stained plate culture is viewed under the microscope, the little colonies are definitely stained and appear highly colored on a colorless or slightly colored background. The colonies appear of considerable size under the low powers of the compound microscope. In fact after four hours of development these colonies are sometimes distinctly visible to the naked eye. Under the oil immersion objective the individual cells are easily seen and the different kinds of bacteria can be separated one from another by the morphology of the cells and their arrangement in the microscopic colonies.

It may be further said that the counts obtained by this method are quite similar to those secured by the ordinary plate method. per c.c. have been examined by both methods. The results obtained indicate that the difference between the counts secured by the rapid method and the ordinary or standard method usually amounts to little more than the variation which occurs between duplicate plates, or between different dilutions in the same analysis by the ordinary plate method.

In the case of recently pasteurized milks or milks with a very low bacterial content, it is necessary to incubate the little plates somewhat longer, *i. e.*, for eight hours.

It seems fair to conclude then that we have here a method which will enable the bacteriologist to obtain a count of the bacteria in milk that corresponds very closely with counts obtained by the standard method in from one eighth to one sixth of the time required by the standard method, and also that the higher the bacterial content, the shorter the time required for the analysis.

W. D. Frost
Department of Bacteriology,
Agricultural Experiment Station,
University of Wisconsin

Societies and Academies

The New Orleans Academy of Sciences

The academy met in the Stanley Thomas Hall, Tulane University, on Tuesday, May 18, the final meeting of the year. Miss Edwina Abbott presented a paper on the transfer of mental habits in children. This is the first time in its history of fifty-one years that the academy has been addressed by a woman. Miss Abbott attempted to prove what has been projected as a theory previous to this that one sort of training fits for another, for instance that Greek and Latin train the memory for other things and mathematics trains the reason for other things, or that neatness in one thing tends towards neatness in others. Her tests were made with children who were trained to select pairs of words, not adjacent, on cards and were then taken to a table on which many objects were placed, left there two minutes, then asked to state what objects they had seen. Memory exercises were also given throughout the term. Two sets of children were selected; one was trained, the other untrained. The training was done from November to May. Three tests were made, one in November, one in May and one in between. The trained children improved from 46 to 76 per cent., the untrained from 51 to 71 per cent., a difference of 33⅓ per cent. in favor of the trained children.

Dr. Bean presented two negro brains before the academy to demonstrate differences in the size and shape of the pons and cerebellum. One brain is from a negro man, aged 41, a hyper-onto-morph, small, thin, wiry, with slight muscular development, who weighed about 100 pounds. The other is from a negro man, aged 41, a meso-onto-morph, tall, well developed, well nourished, with great muscular development, who weighed about 200 pounds. The pons and cerebellum of the hyper-onto-morph are small in both antero-posterior and transverse diameters, 25 and 32 millimeters, respectively, but not so flat as in the meso-onto-morph, where the antero-posterior and transverse diameters are large, 29 and 40 millimeters, respectively. This condition is true not only in the two brains presented, but in eighteen other brains so far examined the same relative difference is noted where the types are distinct. Dr. Mann called attention to the difference in size and shape of the convolutions in the cerebellum of the two brains. The meso-onto-morph has more numerous, more complete and smaller convolutions of the cerebellum than the hyper-onto-morph. The brains of the two men weigh the same, hyper-onto-morph 1,417 grams, meso-onto-morph 1,421 grams.

R. S. Cocks